

For Reference

NOT TO BE TAKEN FROM THIS ROOM

Ex LIBRIS
UNIVERSITATIS
ALBERTAENSIS





Digitized by the Internet Archive
in 2019 with funding from
University of Alberta Libraries

<https://archive.org/details/McDonnell1959>

THESIS
1959(F)
#30

THE UNIVERSITY OF ALBERTA

THE PREDICTION OF ACADEMIC ACHIEVEMENT
OF SUPERIOR GRADE THREE PUPILS

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE
STUDIES IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
MASTER OF EDUCATION

DIVISION OF EDUCATIONAL PSYCHOLOGY

by

MALCOLM WHITNEY MCDONNELL

1959

UNIVERSITY OF ALBERTA
FACULTY OF GRADUATE STUDIES

The undersigned hereby certify that they have read
and recommend to the Faculty of Graduate Studies for acceptance, a
thesis entitled "The Prediction of Academic Achievement of Superior
Grade Three Pupils" submitted by Malcolm Whitney McDonnell in partial
fulfilment of the requirements for the degree of Master of Education.

ACKNOWLEDGMENTS

The writer wishes to thank the members of his committee for their helpful criticism. The assistance received from Dr. R.S. MacArthur, Mr. Wilfrid Pilkington and, in particular, from Dr. G.M. Dunlop, chairman of the Division of Educational Psychology, is most gratefully acknowledged.

The writer also wishes to acknowledge his indebtedness to the Division of Educational Psychology for making available data on which this study is based.

ABSTRACT

In this study, three intelligence tests were compared as predictors of achievement. The investigation was limited to a group of superior pupils selected from the Edmonton grade three classes on the basis of an intelligence quotient of 120 or higher.

The intelligence tests compared were the Detroit Beginning First-Grade, the Progressive Matrices and the California Test of Mental Maturity. Four criteria of achievement were employed: the California Achievement Tests total score and scores in reading, language and arithmetic. Product-moment coefficients of correlation were computed to determine the relationship between each of the intelligence scores and achievement in the several areas. Inter-correlations of the intelligence tests were also determined.

Significant relationships were found between all four measures of achievement and the Detroit and the Matrices tests. The California test proved to be of some value in prediction of total achievement and arithmetic achievement, but was inferior to the other two tests in prediction in these areas. The coefficients of correlation obtained between the California Test of Mental Maturity and both reading and language did not depart significantly from zero and indicated that this intelligence test is of no value in prediction of achievement of superior pupils in these subjects.

The usefulness of the Detroit Beginning First-Grade Intelligence Test for prediction is noteworthy in view of the fact that it had been administered some three years before the other instruments. That the California Test of Mental Maturity should have failed completely as a predictor of reading and language achievement is remarkable in view of its modern design and its heavy weighting with verbal material. The Progressive Matrices, intended to be completely language free, appears to measure a general factor of intelligence which is closely related to school achievement of superior pupils.

TABLE OF CONTENTS

	PAGE
LIST OF TABLES	vii
LIST OF FIGURES	viii
CHAPTER	
I. THE PROBLEM	1
II. RELATED STUDIES	4
Intelligence	4
Achievement	8
Intelligence and Achievement	10
III. THE RESEARCH DESIGN	17
Sources of Data	17
The Sample	18
The Testing Instruments	19
Procedure	25
IV. INTELLIGENCE AND TOTAL ACHIEVEMENT	28
V. INTELLIGENCE AND READING	34
VI. INTELLIGENCE AND LANGUAGE	40
VII. INTELLIGENCE AND ARITHMETIC	44
VIII. INTERCORRELATIONS OF INTELLIGENCE TESTS	48
IX. CONCLUSIONS	51
BIBLIOGRAPHY	56

LIST OF TABLES

TABLE		PAGE
I.	Intelligence Ratings by Teacher Judgements and by a Standardized Intelligence Test	4
II.	Correlation of Achievement with the Binet Intelligence Test	11
III.	Correlation of Achievement with the Stanford-Binet Intelligence Test	11
IV.	Comparison of Three Predictors of Achievement	12
V.	Correlation between Mental Ability and Arithmetic Achievement	13
VI.	Distribution of Letter Ratings of the Detroit Beginning First-Grade Test	20
VII.	Relationship of Total Achievement to Intelligence	29
VIII.	Relationship between Intelligence and Reading Achievement	35
IX.	Relationship between Intelligence and Language Achievement	40
X.	Relationship between Intelligence and Arithmetic Achievement	45
XI.	Intercorrelations of the Intelligence Tests.....	49
XII.	Summary of Relationship between Intelligence and Achievement	52

LIST OF FIGURES

FIGURE	PAGE
1. Distribution of California Test of Mental Maturity Intelligence Quotients of One Hundred Seventy-eight Pupils	18
2. Distribution of Intelligence Test Scores and Total Achievement Scores	30
3. Distribution of Intelligence Test Scores and Reading Achievement Scores	36
4. Distribution of Intelligence Test Scores and Language Achievement Scores	42
5. Distribution of Intelligence Test Scores and Arithmetic Achievement Scores	46

CHAPTER I

THE PROBLEM

The intelligence test has long been recognized as one of the most important instruments for the measurement of a child's ability. At the elementary level it can be used "to predict with considerable success his aptitude in many academic areas" (Passow, 1955, p. 22). Coefficients of correlation ranging from .40 to .60 may be expected between achievement and intelligence (Humphreys and Boynton, 1950). The problem of predicting achievement of superior pupils is closely associated with adequate identification of this portion of the school population. Martens (1951) expresses confidence that, with the tools currently available, the school can identify the child of great promise.

It was demonstrated by Burt (1945) and by Alexander (1953) that teacher judgements are inferior to psychological tests in the assessment of intelligence and the prediction of achievement. Emmett (1954) found that school marks are likewise less reliable than intelligence tests. Despite the influence on achievement of such other factors as motivation, time devoted to study, physical and emotional traits and environmental influences, Terman (1947) reaffirmed his contention of thirty years earlier that the I.Q. is one of the most important facts that can be learned about a child.

Identification of the gifted and prediction of achievement are matters of immediate concern today. Adequate training of superior pupils is increasingly required to meet the growing needs of society, particularly in technological fields. The school is under "constant criticism for its apparent failure to provide for children of special ability and to challenge these pupils to greater effort" (Greene et al., 1947, p. 99). Passow (1955) and Laycock (1958) deplore the detrimental effect on the nation's manpower of failure to discover its talented youth.

Concern for the gifted is not new. Pintner (1930) refers to attempts at solution of this problem, notably in Detroit, dating from 1915. Identification of superior pupils and prediction of their achievement, however, has lagged behind interest in the child of low ability. Renewed interest in the former group is evident at the present time. Special programs have been adopted in various parts of Alberta including Calgary (Promotion Policies in Alberta, 1957), Lethbridge (Kimmitt, 1958) and Athabaska (Gault, 1957). The relationship between theory and practice in the identification and treatment of talented students in Alberta composite high schools was the subject of a recent investigation by Housego and Mowat (1959). Realization of the necessity for adequate educational opportunities for superior children is widespread. Levirs (1957) recently made a survey of experimental programs in British Columbia. The workshop on Special Needs at the Canadian Conference on Education recognized the desirability of some type of special program for exceptional

pupils. (McLeod, 1958). A New York study of 3500 superior grade five pupils is one of a number of investigations embraced by the Talented Youth Project, undertaken in 1953 by the Horace Mann-Lincoln Institute of School Experimentation (Passow, 1957).

The problem of identification and prediction of achievement of gifted pupils is today receiving warranted attention. Intelligence tests currently available make it possible for the school to discover its superior talent. Adoption of the best possible program for this purpose is dependent upon careful assessment of various intelligence tests as predictors.

CHAPTER II

RELATED STUDIES

Intelligence

Burt's conclusion that intelligence is the predominant constituent of educational ability (Kemp, 1955) has been reaffirmed by other investigations. Richardson (1954) found the intelligence test to be the best single predictor of future success. Gates and Jersild (1948) concluded that, on the whole, pupils with high I.Q. earn high grades.

The availability of standardized intelligence tests for prediction of achievement makes dependence on less objective and less reliable predictors unnecessary. Teacher judgements frequently form the basis of identification and prediction. Alexander (1953) compared teacher selections of pupils of highest and lowest intelligence with classification of the same subjects by means of a standardized intelligence test. The results obtained are shown in Table I.

TABLE I

INTELLIGENCE RATING BY TEACHER JUDGEMENTS AND BY
A STANDARDIZED INTELLIGENCE TEST (Alexander, 1953)

Intelligence Category	Teacher Ratings	Number of Teacher Ratings Confirmed by Test
Among the five highest	199	114 or 57.3%
Among the five lowest	185	107 or 57.8%
	384	221 or 57.6%

N = 1030

Teachers' judgements were found to agree with classification by a standardized intelligence test only 58% of the time. De Haan (1957) recognized the role of systematic observations by teachers, along with intelligence testing, in assessing superior talent. He attaches primary importance, however, to the latter.

School marks constitute another criterion for prediction of future achievement. Marks awarded on the basis of teacher-made tests, however, are subject to variations in methods of evaluation and caution is warranted in their use as predictors. Carter (1953) has shown that personal factors add to the unreliability of teacher-made tests as compared with standardized achievement tests. The latter have been found useful in prediction. Peel and Rutter (1951) found that consideration of English and arithmetic marks from standardized tests, together with results of an intelligence test, improved prediction over the use of the intelligence test alone.

All educators will agree that chronological age is not a satisfactory predictor of achievement. A committee on promotion policies found that, in 1954, 17.6% of Alberta pupils in grades one to eight were over age for their grades.

With reference to individual intelligence tests, Gates and Jersild state that "there is impressive evidence that general intelligence as measured by the Binet and similar tests corresponds fairly closely to success of the child in the conventional school program." (1948, p. 252). Cronbach expresses confidence in the

predictive value of group tests, which are used more commonly than individual tests. He finds that the majority of group tests are adequately reliable.

One limitation of group tests may adversely affect certain pupils. The establishment of satisfactory rapport is necessary if the score obtained is to reflect accurately the intelligence of the subject. In the group situation, as compared with individual testing, the examiner is at a disadvantage in recognition of the pupil who does not participate fully. The difficulty may be overcome, in large measure, by administration of several measures of intelligence.

Group tests almost invariably make heavy demands on language. Due to the influence of the language factor, low scores on tests may be indicative of deficiency in reading rather than general low ability. Non-language tests, or sections in tests, represent an attempt to meet this criticism. The possibility of adequately measuring intelligence without reference to language has been questioned. "If high intelligence involves ability to do abstract thinking, it is hard to conceive of an adequate high level test that does not involve vocabulary and concepts" (Cronbach, 1949, p. 188). Allan and Bissell (1950) concluded, from a study of verbal and non-verbal group intelligence tests, that the two types of instruments may be tapping different mental functions.

Differences in the construction of group intelligence tests reflect, to some degree, conflicting theories of intelligence. The Progressive Matrices test is an example of an instrument designed to measure the general factor of Spearman's two-factor theory (Westby, 1953). This theory maintains that all intellectual activities share a single common factor, "g". In addition there are numerous specific, or "s", factors each applicable to a single type of mental activity. Kelly (1928) and Thurstone (1938) found groups of factors to be common to some intelligence tests and not to others. Spirited controversy has been maintained for many years between the supporters of multiple-factor theory and the Spearman school. The presence of numerous sub-classifications of intelligence in the California Test of Mental Maturity reflects the expressed intention of the authors to examine more or less independent factors of mental ability (Manual, California Test of Mental Maturity, 1953). The Detroit Beginning First-Grade Intelligence Test, on the other hand, seems to reflect the unitary concept of intelligence held by Binet and his immediate followers, prior to the emergence of the more recent theories.

Summary

Research seems to have established that the intelligence test is the best single instrument for identification of superior ability. "The intelligence test does not measure equally well all types of

capacity to learn, but those which it does reveal most reliably are of great importance" (Gates and Jersild, 1948, p. 260).

Achievement

The school is constantly concerned with measurement of the achievement of its pupils. Tests constructed at the classroom level are common measuring instruments. Less objective day-to-day estimates of pupils' progress are also employed. Tests made by the teacher to fit class needs have an important place in a testing program and, indeed, have been termed indispensable by Cronbach (1949). Teacher-made tests have been criticized, however, for their emphasis upon "informational questions of the 'name', 'define', 'who', 'what', 'when' and 'where' types and the lack of items designed to measure understandings and ability to do inferential thinking" (Cook, 1950, p. 1466).

An alternative measuring instrument is the standardized achievement test. Such an instrument may be desirable in an evaluation program which extends beyond a particular school or school system. Its advantages over teacher-made tests include quality of construction, economy of time, uniformity of evaluation, and ease of administration.

An evaluation of achievement is usually required in as many subjects of the curriculum as possible. Here the test-maker is confronted with a difficult problem. It is desirable that a test have a wide basis of standardization and that it be as universally applicable as is possible. At the same time, due regard must be

given to variations in local courses of study. The matter of curricular validity is particularly important in the sciences and the social studies. One solution is publication of achievement test batteries restricted in content to such basic skill subjects as reading, language, spelling and arithmetic. An alternative practice is provision of partial batteries, devoted only to the skills, as well as complete batteries which embrace all subjects.

Among numerous achievement test batteries on the market, many of excellent quality are available at the elementary level. The Metropolitan Achievement Test battery has been described as one of the earlier tests which has "maintained and set the pace" (Findley, 1953) since its appearance in 1931. It has been thoroughly and expertly standardized. Several equivalent forms are available at each of five educational levels. Partial batteries of skills are also available at the higher levels. The Metropolitan tests do not escape the criticism of inclusion of old test items and emphasis on factual knowledge rather than understandings. The Iowa Every-Pupil Tests of Basic Skills represent "one of the best series available for measuring many fundamental skills" (Bryan, 1953). Their inclusion in any evaluation program is recommended. The Stanford Achievement Tests, a pioneer in the field in 1923, is another well known battery. It has been described as one which will undoubtedly retain its position as "one of the finest achievement tests available" (Hanna, 1953). Norms are based on 300,000 pupils from 173 communities in 32 states. The tests have been criticized for lack of

agreement of content with curricular aims and sound, generally approved practice. The battery employed in the present study, the California Achievement Tests, is another series which is rated very highly (Odell, 1940). These tests are discussed more fully in Chapter III.

Summary

Standardized achievement tests are preferable to other measuring instruments when the effectiveness of intelligence in prediction is under study. For evaluation of children from different schools, or different areas, it is advisable that achievement test batteries be limited to the basic skill subjects.

Intelligence and Achievement

A survey of educational research reveals that the relationship between achievement and intelligence has been the subject of numerous investigations. Most of the studies reported deal with non-selected populations rather than with gifted pupils. Bishton (1955) has stated that the gifted do not constitute a discrete category of individuals but differ from others only relatively. He describes them as "the more extreme deviates on a continuous scale in matters of physical, social, psychological and educational growth and development"(1957, p. 204). The prevalence of prediction studies is consistent with Bolton's statement that the most common use of an I.Q. in the school is to predict scholastic achievement (1955).

Burt (1921) examined the degree of relationship between achievement

and intelligence as measured by the Binet tests. Coefficients of correlation for seven school subjects are shown in Table II.

TABLE II
CORRELATION OF ACHIEVEMENT WITH THE BINET
INTELLIGENCE TEST (Burt, 1921)

Subject	Correlation with Intelligence
Composition	.63
Reading	.56
Arithmetic	.55
Spelling	.52
Writing	.21
Handiwork	.18
Drawing	.15

Intelligence was found to correlate much more highly with some subjects than with others. Gates and Jersild (1949) consider the coefficients for the last three subjects so small as to be practically negligible. Bond (1940) found similar variation in the relationship of school achievement and the Stanford-Binet Intelligence Test. Coefficients are indicated in Table III.

TABLE III
CORRELATION OF ACHIEVEMENT WITH THE
STANFORD-BINET INTELLIGENCE TEST (Bond, 1940)

Subject	Correlation with the Stanford-Binet Intelligence Test
Reading vocabulary	.79
Reading comprehension	.73
Literary acquaintance	.60
English usage	.59
History	.59
Biology	.54
Geometry	.48
Spelling	.46

The superiority of the intelligence test over any other single predictor of success in grammar schools is reported by Peel and Rutter (1951). They found one intelligence test to have almost as good predictive value as a battery of tests including intelligence and skills. Stubbins (1940) compared three grammar school entrance examinations as predictors of achievement. The criteria of achievement were the General Certificate of Education Examinations. Coefficients for the respective entrance examinations are shown in Table IV.

TABLE IV
COMPARISON OF THREE PREDICTORS OF ACHIEVEMENT
(Stubbins, 1940)

N	Grammar School	Correlation with General Certificate of Education Examination
	Entrance Examination	
	English	.355
1582	Arithmetic	.284
	Intelligence	.422

Intelligence was found to be the best predictor of academic achievement.

In an investigation at the junior high school level, Gavinchuk (1954) found a substantial relationship between intelligence and school achievement. Of several tests employed, none proved consistently superior to the others as a predictor in all subjects. Climenhaga (1955) found a marked correlation between mental ability

and achievement of grade seven pupils. Table V shows the coefficients obtained for four classes of schools.

TABLE V
CORRELATION BETWEEN MENTAL ABILITY AND
ARITHMETIC ACHIEVEMENT (Climenhaga, 1955)

Type of School	N	Coefficient of Correlation
Urban	380	.69
Town	222	.64
Graded rural	213	.64
Ungraded rural	201	.62

Studies by both Wrigley (1955) and Bishton (1957) dealt with groups of superior pupils. Very small coefficients obtained by Wrigley, some so small as to indicate almost a breakdown in prediction, were attributed to the selective nature of the sample. In this connection Cronbach points out that "a test which has a highly satisfactory coefficient of reliability for groups containing wide differences may be unsatisfactory for comparing pupils in a highly selected group" (1949, p. 62). Using the California Achievement Tests battery to measure superior grade eight pupils, Bishton (1957) found a significant relationship between achievement and intelligence. "Superior pupils" were defined as those who had obtained scores of 120 or more on a standardized intelligence

test. In reading, arithmetic and language they were found to be sixteen months ahead of their actual grade placement.

In a comparison of the predictive power of verbal and non-verbal sub-scores of the WISC, Stroud and Bloomers concluded that "the general average is still far and away the most revealing score" (1957, p. 26). In another study of verbal, performance and full-scale WISC scores as predictors of achievement, Barratt and Baumgarten (1957) concluded that one characteristic of achievers is their relatively high verbal ability. They also found, in the cases of non-achievers, that their inadequacy in using verbal symbolism made it difficult to obtain a true measure of their scores in some subjects.

Evidence for the predictive value of the performance type of intelligence test is presented by Barratt (1956). Raven's Progressive Matrices and the Columbia Mental Maturity Scale were under consideration as possible alternatives to the WISC due to time limitations. The former test was selected as the better substitute on the basis of a correlation of .754 with the WISC as compared with .576 for the Columbia. Bolton (1955) found that the application of a time limit to the Progressive Matrices improved its predictive power with respect to grade four achievement.

Bailey's investigation (1949) parallels the present study in that she compared predictors of achievement at the same (grade three) level and employed several of the same instruments, the Detroit Beginning First-Grade Intelligence Test, the California Test of

Mental Maturity and the Progressive Achievement Tests. Her study was not, however, limited to a superior group. A correlation coefficient of .67 was obtained between achievement and the Detroit test and .66 between achievement and the California. It was found, too, that the Detroit correlated more highly with the Stanford-Binet (.81) than did the California (.58). Of interest is Bailey's finding that the California Test of Mental Maturity is lacking in power of discrimination among the more capable pupils. This feature of the California is not uncommon among group intelligence tests (Powell, 1956). A relationship which may exist between two variables for a heterogeneous sample may not be evident when only a small portion of the distribution is under consideration.

Summary

Prediction studies indicate a marked degree of correlation between school achievement and intelligence. A standardized intelligence test is generally found to be a better predictor of achievement than any other single instrument. Prediction can be improved by a battery of tests of intelligence and achievement combined with careful teacher observation (Wrigley, 1955). No one intelligence test has been established as superior to others for prediction in all subjects and at all grade levels (Gavinchuk, 1954). Low coefficients of correlation may be expected

with selected groups. Pupils with good verbal ability appear to have an advantage on many intelligence tests. The performance type test has been shown to have a definite place in a well-rounded testing situation.

CHAPTER III

THE RESEARCH DESIGN

Sources of Data

In June 1956 a grade three survey was conducted by the Division of Educational Psychology of the University of Alberta in cooperation with the Edmonton Public School Board and the supervisory staff, principals and teachers of the Edmonton Public School system. The project had the support of the Alberta Committee on Educational Research. Two group intelligence tests were administered to the grade three pupils of Edmonton. These were followed by the California Achievement Test Battery of the appropriate level. The intelligence tests were administered by Faculty of Education students with special training in this field, while the achievement tests were administered either by these students or by classroom teachers under their supervision. Every effort was made to ensure uniformity in the testing situation. Scoring and tabulation of results were done by the Division of Educational Psychology. In addition, pertinent information about each pupil was recorded on specially prepared data assembly sheets.

The Sample

The present study of prediction of achievement was restricted to superior pupils. The criterion of selection of the sample for this purpose was a score of 120 or higher on the California Test of Mental Maturity. On this basis, 178 pupils were chosen from the total Edmonton grade three population of some 3700. The distribution of intelligence scores of this highly selected group is shown in Figure 1.

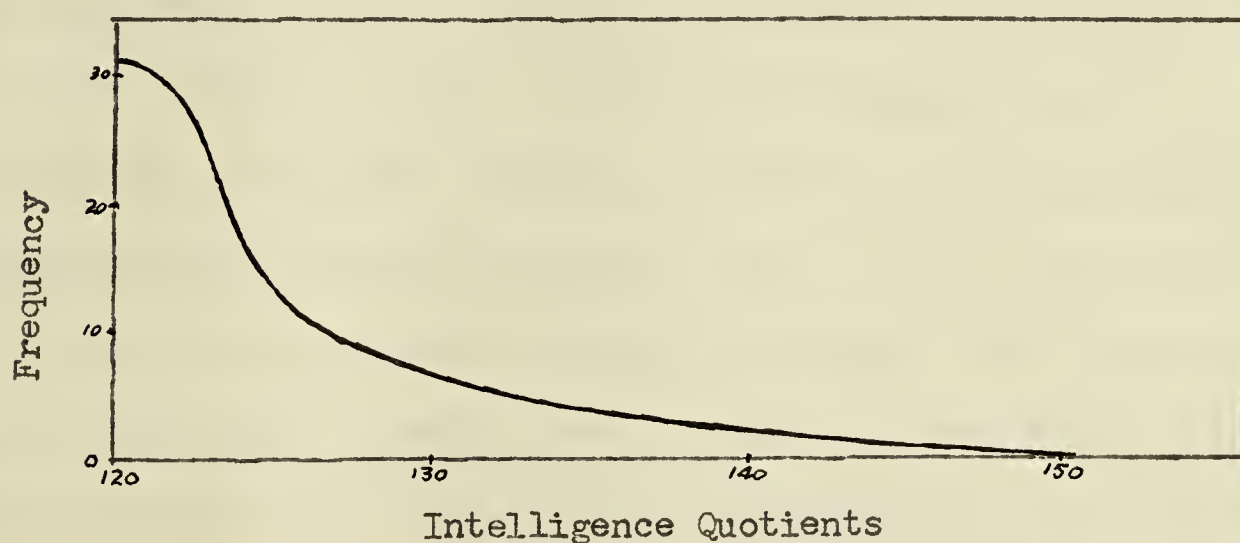


FIGURE 1

DISTRIBUTION OF CALIFORNIA TEST OF MENTAL
MATURITY INTELLIGENCE QUOTIENTS OF ONE
HUNDRED SEVENTY-EIGHT PUPILS

The Testing Instruments

Three one-period group intelligence tests were used in the Edmonton grade three study: the Detroit Beginning First-Grade Intelligence Test (Revised), Raven's Progressive Matrices (1947) and the California Short-Form Test of Mental Maturity. The achievement tests employed were the California Achievement Tests, Complete Battery, Primary, form CC.

Detroit Beginning First-Grade

Engel and Baker's Detroit Beginning First-Grade Intelligence Test has been a familiar testing instrument since publication of the first edition, in 1921, by World Book Company, New York. This study refers to the 1937 revision of the test. Kent recommends that the Detroit test be "kept in stock" (1950, p. 123). Its test items, like those of its companion Advanced First-Grade, have been described as "the usual ones" (Jordon, 1940, p. 218). No reading is required. There is no time limit. The manual of directions and key recommend administration of the test to groups no larger than 12.

1. Validity. The authors claim a correlation of 0.76 between weighted scores of the Detroit Beginning First-Grade and the Stanford-Binet MA's of first-grade children. Retention of each test item was decided on the basis of its ability to distinguish among bright, average, and slow children in a group of 300 representing

all three levels of ability. Jordon (1940) questions this procedure in the Detroit tests since the division into high, middle, and low levels was determined by a preliminary use of the Detroit tests themselves.

2. Reliability. A split-halves reliability of .91 ($N = 116$) by the Spearman-Brown formula is reported in the manual, together with a coefficient of .76 ($N = 407$) by the re-test method after a four-month interval.

3. Norms. A table is provided assigning seven letter ratings according to weighted scores obtained at age levels from five years to eight years, six months. It is based on the distribution of scores of 10,000 Detroit first-grade pupils. Table VI shows the percentage distribution and approximate I.Q.'s for the letter gradings.

TABLE VI

DISTRIBUTION OF LETTER RATINGS OF THE
DETROIT BEGINNING FIRST-GRADE TEST

Group	Rating	Per Cent	Approximate I.Q.
X	A	8	118 or higher
	B	12	111 - 117
Y	C+	18	105 - 110
	C	24	96 - 104
	C-	18	90 - 95
Z	D	12	83 - 89
	E	8	82 or lower

Raven's Progressive Matrices.

J. C. Raven's Progressive Matrices, published by H. K. Lewis and Company, are designed as a highly discriminating, non-verbal and "culture-free" intelligence test (Shipley, 1949). They consist of a series of matrices or abstract designs from which parts have been removed. The 1947 edition of the test, used in this study, adds a section to the original 1938 edition to make it more suitable for children.

An assessment of thought processes which are independent of even elementary education is an advantage claimed for the Matrices over verbal intelligence tests (Foulds and Raven, 1950). No language requirement is evident for performance of the test items, although Jones (1952) found that solutions may depend partly on the ability of the child to summarize relations in verbal form. Language may be eliminated from even the instructions for the test by the substitution of suitable demonstration. The author claims that the test is applicable to any race speaking any language.

The Matrices test is described by Stephenson as a "series type of g test" (1949, p. 47). Wechsler (1949) commends it as the first comprehensive attempt to measure intelligence in terms of a single function, that of visual perception. Its success indicates that a qualitative level in perception, as in verbal situations, makes possible an assessment of intelligence. Publication of the Matrices is recognized by Westby as "the first spectacular success by the British g school ... upon the empirically composed tests of Binet

and his followers" (1953, p. 418). A g-loading of over .80 has been claimed for the test (Jones, 1956). This indicates the extent to which the test has been found to depend on a general factor of intelligence which enters into all test situations. This general factor, which Spearman labelled "g", was thought to be ability to see relations. Factor analysis employed by the War Office Selection Board in their use of the Matrices suggested almost total dependence on g with the presence of some spatial perception factor (Westby, 1953).

1. Validity. For children under seven, the manual claims a correlation of .50 with the Terman-Merrill scale and with the Crichton Vocabulary Scale. This figure rises to .65 by age nine. Tuddenham (1958) obtained correlations of .40 to .45 with other intelligence tests, including the California Test of Mental Maturity.

2. Reliability. A low retest coefficient of .65 is reported by the author for age seven, .80 for age nine. Low reliability at lower ages might be due to inability of younger children to form comparisons and reason by analogy.

3. Norms. Norms based on 608 pupils from age five to age $16\frac{1}{2}$ are presented. Westby (1953) deems them not satisfactory. Green and Ewart (1955) found median scores to be from two to six points higher than the published norms, while Sperrazo and Wilkins (1958) confirmed Raven's norms but found too low a ceiling for the average class.

California S-Form of Mental Maturity.

The third intelligence test upon which this study is based is the Primary (grades one to three) battery of the California Short-Form Test of Mental Maturity. This test was revised in 1953 with respect to percentile and grade placement norms. The authors, Sullivan, Clark and Tiegs, sought to develop "as valid a test of mental maturity" (1953, p. 2) as can be secured with a one-period group test. Kuhlmann's evaluation of the unabbreviated form as "among the best on the market" (1940, p. 209) testifies as to their success. The inclusion in the test of non-verbal material is commended by Garrett (1949). Cattell (1940) comments favorably on its design and convenience.

The battery yields three I.Q. scores: Language, Non-language and Total. Sub-scores are also available for spatial relations, logical reasoning, numerical reasoning and verbal concepts. The reviewers agree that the sub-scores are considerably over-emphasized. Cattell (1940) takes issue with the term "maturity." The S-Form of the test requires 42 minutes.

1. Validity. A high correlation with the Stanford-Binet is claimed but no exact coefficient is stated. Sheldon and Manolakes (1954) found a coefficient of .70 between the California Test of Mental Maturity and the Stanford-Binet.

2. Reliability. A split-halves coefficient of reliability of .921 is stated for the whole test.

3. Norms. Adequate norms are provided: Mental Age and Intelligence Grade Placement norms as well as Percentile norms and a table of differences in achievement to be expected of groups with varying median I.Q's. These norms are based on a controlled sampling of over 125,000 cases.

California Achievement Tests.

In this study, achievement was measured by the Primary Battery (grades I, II, III, IV) of the California Achievement Tests, the new (fourth) edition of Tieg and Clark's Progressive Achievement Tests. The battery consists of tests in reading, arithmetic, and language, each of which is divided to provide some 27 sub-scores. The authors emphasize the diagnostic value of these sub-tests and the importance of the diagnostic profile provided for each pupil. Schindler (1953) and Findley (1953) both criticize the term "diagnostic." Shores (1953) finds that the implied claims made for the profiles are misleading. Odell (1940) suggests that sub-scores and profiles might better be described as "analytic." The arithmetic test has been criticized for undue emphasis on obtaining the right answers and for having lost sight of goals in arithmetic teaching. Shores (1953) finds no evidence of referral, since 1933, to the courses of study on which the tests were based. He urges improvement of their logical validity. Witty (1949) describes them, however, as having no equal at the present time as survey and diagnostic instruments.

The time for the battery is one hour, thirty-five minutes. A good manual is supplied. Test booklets have been carefully prepared to make for maximum ease of administration, scoring and recording.

Procedure

Data used in this study included three intelligence test scores. These were Detroit Beginning First-Grade and California Test of Mental Maturity intelligence quotients and raw scores on the Progressive Matrices. The Detroit test had been administered at the beginning of grade one and the other two intelligence tests were given in grade three. Achievement was based on the California Achievement Tests, also administered in the grade three year. This battery of achievement tests provides scores in reading, arithmetic, and language in addition to the total score.

The purpose of the study was to determine the degree of relationship, if any, between achievement and intelligence. Each of the four achievement scores was compared with each of the intelligence scores by calculating product-moment coefficients of correlation. Since correlation may be found as the result of sampling errors, the coefficients obtained were tested for significance. Starting with the hypothesis of no actual relationship between achievement and intelligence, Garrett's tables (1953, p. 200) were employed to ascertain if the obtained r 's were sufficiently high to warrant rejection of this null hypothesis. Significance of differences of r 's was also tested.

Coefficients of correlation which were found to be significant served as a basis of comparison of the three intelligence tests as predictors of achievement. As it is recognized that intelligence tests do not predict equally well in all subjects, comparison of achievement as judged by the four criteria was of interest. Of special interest in this study was the question of how well the intelligence tests predicted achievement in the light of the very selective nature of the sample. The inquiry into the relative predictive value of the intelligence was deemed to be of value, too, because of the differences in the nature of the tests and because of the time of administration. Raven's Progressive Matrices are a visual perception figure test as compared with the highly verbal California and the partially verbal Detroit. The Detroit had been administered some three years before the Raven and the California and was at a disadvantage due to this time lag. Allen (1945) concluded from the disparity between intelligence test scores in grade four and in grade one that prediction of achievement is much more reliable over short periods than over long time intervals.

Various intelligence tests may measure different aspects of intelligence or emphasize in different degree certain types of mental activity. Moreover, it has been found that some intelligence tests which discriminate well among pupils in a heterogeneous population fail to discriminate as adequately when a superior group

is under consideration, as in the present situation. In view of these considerations, it was necessary to calculate the inter-correlations of the several intelligence tests, including the tests in language and non-language of the California Test of Mental Maturity.

CHAPTER IV

INTELLIGENCE AND TOTAL ACHIEVEMENT

Alternate approaches to the measurement of intelligence are evident in the wide differences in design of various testing instruments. The California Test of Mental Maturity (Primary, S-Form) is a modern, academic test applicable to grades one, two and three. The contribution of language, for which a separate score is provided, is specified by the authors as 37% of the whole test. The Detroit Beginning First-Grade Intelligence Test, intended for children with no formal schooling in language, is less verbal than the California. It requires a good deal of pencil-and-paper performance in compliance with oral directions. The Progressive Matrices are quite different from either of the other two tests. They are designed to be completely independent of language and aim at the measurement of intelligence through the assessment of quality of perception.

As has been noted, the Detroit Beginning First-Grade test was administered some three years before the other instruments. It was expected that this disadvantage would lower its predictive power as compared with the California and the Progressive Matrices.

These three intelligence tests were compared as predictors of achievement of the selected group of superior pupils with which this study is concerned. Scores of 178 such pupils on a standardized achievement test were compared with their scores on the intelligence tests by calculation of product-moment coefficients of correlation.

The criterion of achievement was the total score on the California Achievement Tests. Table VII shows the correlations obtained.

TABLE VII
RELATIONSHIP OF TOTAL ACHIEVEMENT TO INTELLIGENCE

Intelligence test	N	r	Level of significance
Detroit Beginning First-Grade	178	.33	.01
Progressive Matrices	178	.34	.01
California Test of Mental Maturity	178	.16	.05

Positive coefficients of correlation were obtained between total achievement and intelligence as measured by each of the three testing instruments. The coefficients were small, ranging from .34 for the Detroit Beginning First-Grade to .16 for the California Test of Mental Maturity. The coefficient for Raven's Progressive Matrices (.33) was almost equal to that for the Detroit Beginning First-Grade.

The distribution of the several scores from which these coefficients were calculated are shown in Figure 2. It is of interest to note that six scores on the Progressive Matrices were the highest attainable, 36, indicating a somewhat low ceiling in this test.

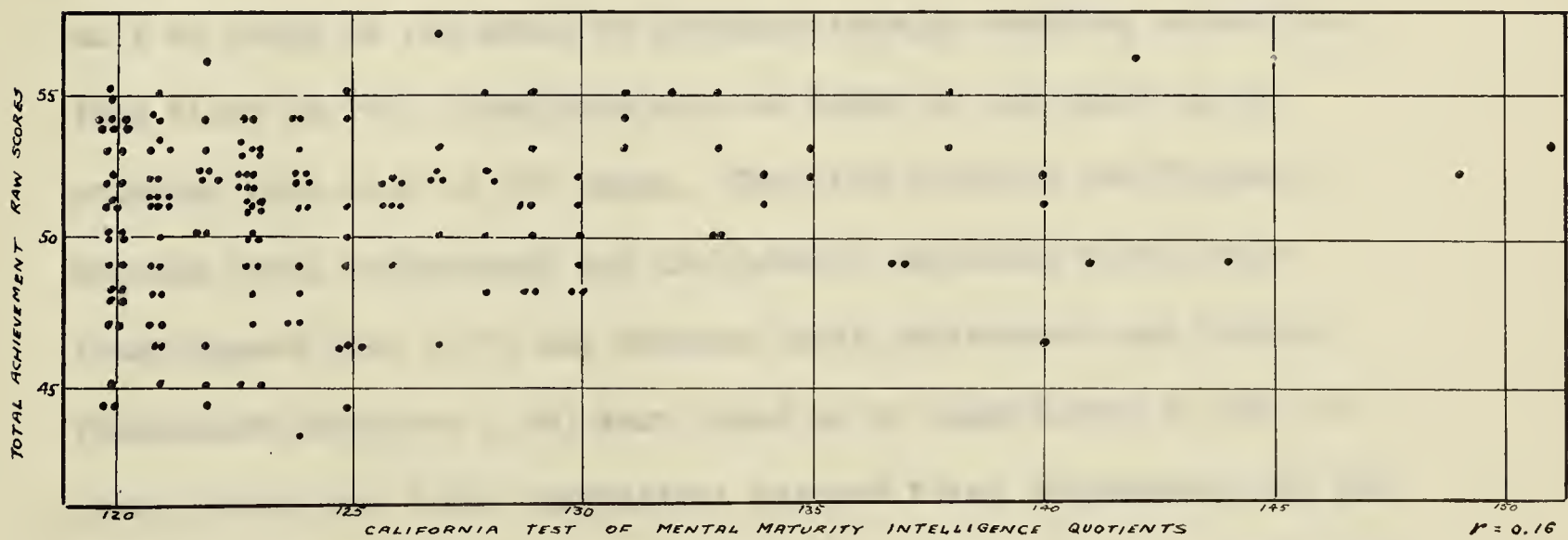
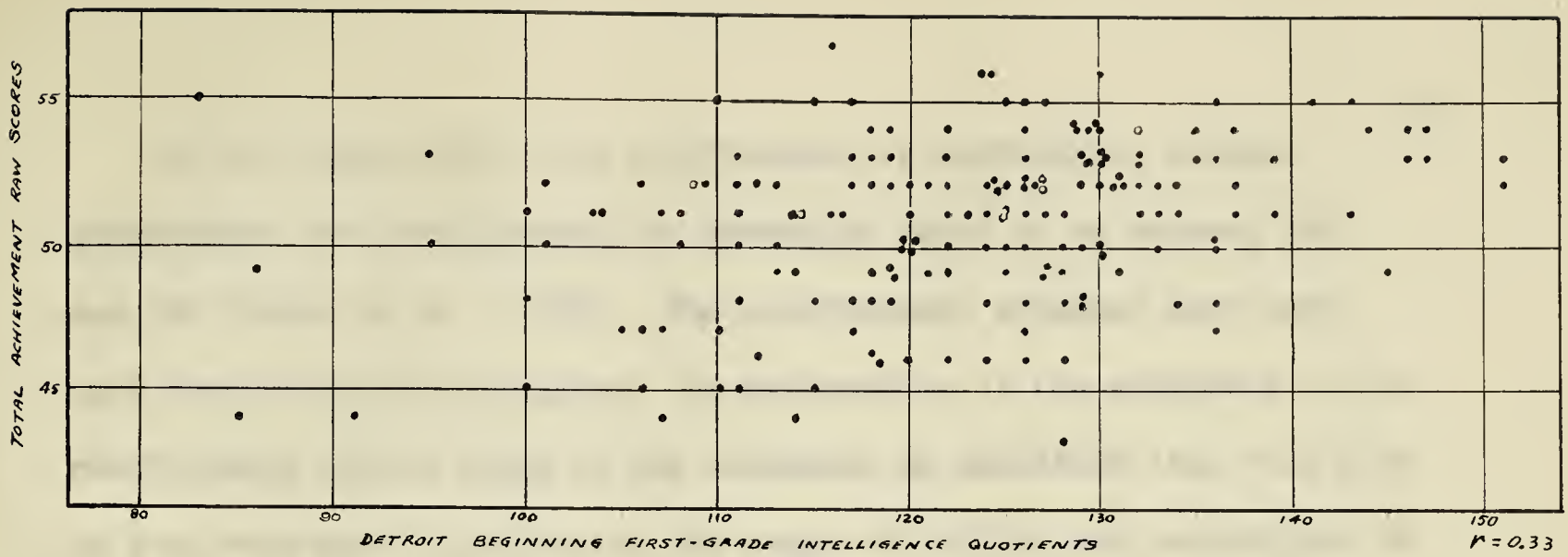


FIGURE 2

DISTRIBUTION OF INTELLIGENCE TEST SCORES
AND TOTAL ACHIEVEMENT SCORES

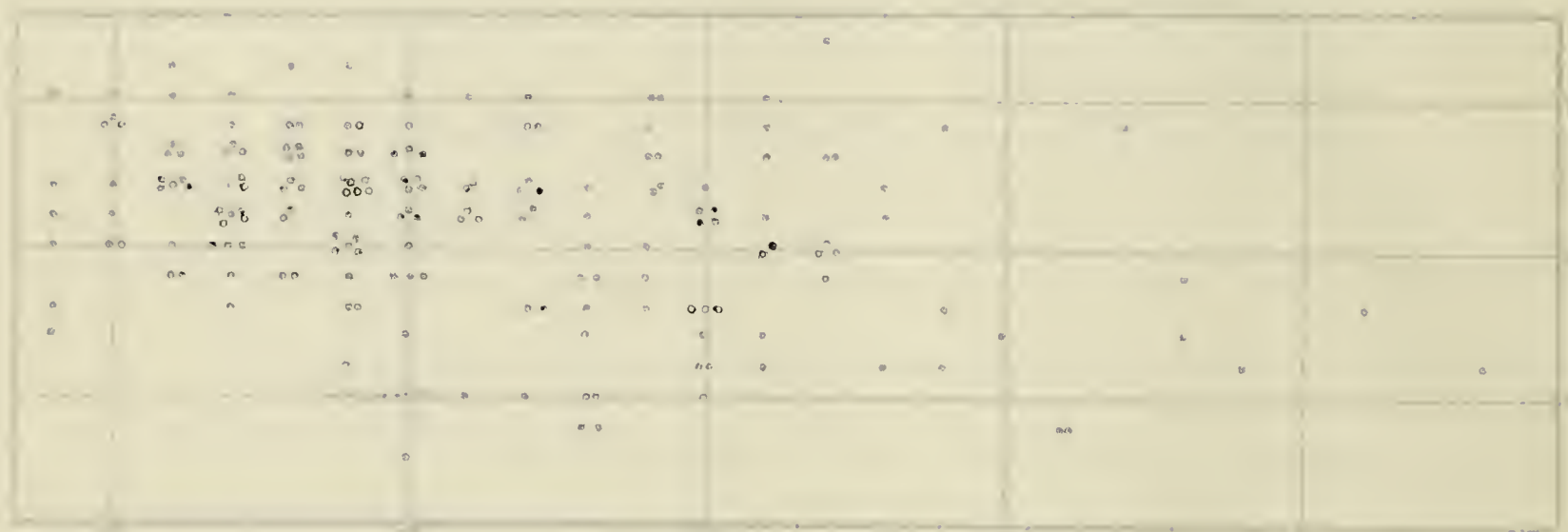
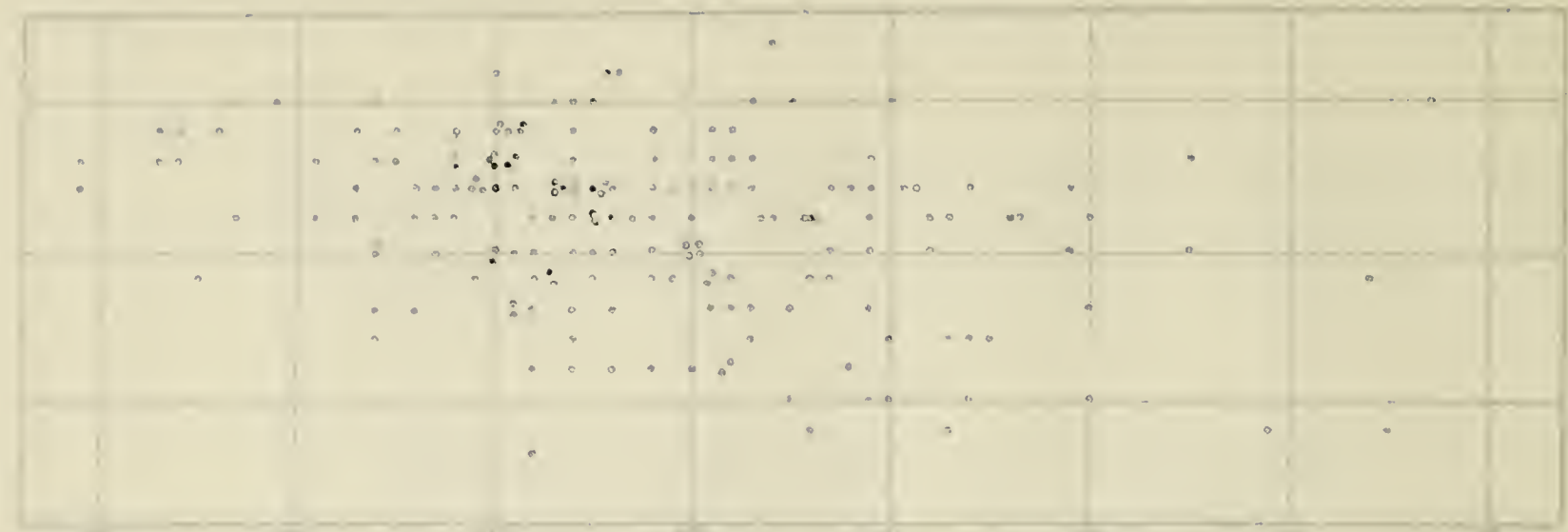


FIGURE 3
 DISTRIBUTION OF INDIVIDUALS IN THE ROOMS
 AND TOTAL ROOMS IN THE ROOMS

It has been stated that coefficients of correlation between achievement and intelligence are generally found to be between .40 and .60 (Green et al., 1947). The coefficients obtained here were much lower than these figures. An explanation of the smallness of the coefficients may be found in the statement by Guildford that "the size of r is very much dependent on the range of ability and variability of the measured values in the correlated samples" (1956, p. 319). The lower the variability in the sample, the lower the correlation which may be expected. In the limiting case, if all I.Q.'s were the same, no r could be computed.

The obtained coefficients of correlation between total achievement and intelligence were tested for significance of departure from zero. Entering Table 25 (Garrett, 1953, p. 200) with 176 degrees of freedom, it was found by interpolation that to be significant at the .05 level the numerical value of an obtained r must be at least .15. The required numerical value of r for significance at the .01 level is .19. This means that, on the hypothesis of an actual population r of zero, an r as large as .15 would be obtained through sampling errors only five times in 100. Similarly an r as large as .19 would be so obtained only once in 100 times. Thus the obtained coefficients between total achievement and the Detroit Beginning First-Grade Intelligence Test (.33) and between total achievement and Raven's Progressive Matrices (.34) were found to be significant at the .01 level, while the lower coefficient between total achievement and the California Test of Mental Maturity (.16) was found to be significant at the .05 level.

The significance of the differences between the coefficients was investigated. In the absence of a test which is completely satisfactory in the present situation, the formula

$$t = \frac{(r_{12} - r_{13}) \sqrt{(N - 3)(1 + r_{23})}}{\sqrt{2(1 - r_{12}^2 - r_{13}^2 - r_{23} + 2r_{12}r_{13}r_{23})}} \quad (\text{Cornell, 1956, p. 244})$$

was employed. Although it is applicable to correlated r 's, its use also implies random selection of the sample from which the r 's are obtained. In this study, as has been stated, superior pupils only are included in the sample. The test, therefore, may be regarded as a non-conclusive but nevertheless valuable indication of the significance of differences of coefficients of correlation.

For the difference of .18 (.34 - .16) between the correlation of the Matrices with total achievement and the correlation of the California with total achievement, a t -value of 1.90 was obtained. This is lower than the t -table figure of 1.97 which is required at the .05 level in order to claim significant departure from zero. In discussing the relative value of the three intelligence tests as predictors of total achievement, therefore, it must be recognized that the significance of differences between r 's has not been established.

With the reservation stated above, it may be said that the Progressive Matrices and the Detroit Beginning First-Grade Intelligence Test proved to be the best predictors of total achievement of superior pupils. The coefficient of correlation obtained between

the California Test of Mental Maturity and total achievement, .16 as compared with .34 and .33 indicates that it is not as useful as the Raven and the Detroit tests as a predictor in this situation.

It will be remembered that the Detroit Beginning First-Grade Intelligence Test was administered some three years before this study commenced while the Progressive Matrices and the California Test of Mental Maturity were given at the same time as the achievement tests. For this reason it might be expected that the efficiency of the Detroit test as a predictor would be lowered. The fact that the three year old Detroit scores were found to be almost equal to the Matrices and superior to the California Test of Mental Maturity is a tribute to the effectiveness of this predictor.

Summary

In a comparison of the three intelligence tests as predictors of total achievement of superior grade three pupils, Raven's Progressive Matrices and the Detroit Beginning First-Grade Intelligence Test were found to be almost equally effective. Both were found to be superior to the California Test of Mental Maturity. The r 's of .34 and .33 were found to be significant at the .01 level, while the r of .16 for the California was significant at the .05 level. The effectiveness of the Detroit Beginning First-Grade is noteworthy in view of its earlier administration.

CHAPTER V

INTELLIGENCE AND READING

Reference was made in Chapter IV to the difference in design of the three intelligence tests under consideration. The Detroit measures incidental learning and ability indicative of school readiness, with a minimum of formal verbalization. The California includes considerable verbal material appropriate to the child of the primary grades, while the Progressive Matrices are quite independent of language. These three tests were compared as predictors of reading achievement.

In addition to a total achievement score, the California Achievement Tests yield scores in reading, arithmetic and language. Content of the battery does not extend beyond these relatively universal skill subjects. The reading score is a composite of achievement in vocabulary and in comprehension. The vocabulary portion includes word form, word recognition, and meanings of opposites. Comprehension includes following directions, understanding stated facts, and interpretation of short statements.

Coefficients of correlation between reading achievement and each of the intelligence tests are shown in Table VIII.

TABLE VIII

RELATIONSHIP BETWEEN INTELLIGENCE AND READING ACHIEVEMENT

Intelligence test	N	r	Level of significance
Detroit Beginning First-Grade	178	.22	.01
Progressive Matrices	178	.27	.01
California Test of Mental Maturity	178	.09	---*

*Not significant

Positive coefficients of correlation were obtained in all three cases. Two were slightly lower and one considerably lower than the coefficients found between total achievement and intelligence. The scattergrams in Figure 3 show the distribution of the scores in reading achievement and the three intelligence test scores.

The coefficients obtained were tested for significance of departure from zero. For an N of 178, a coefficient of .19 is required before more than chance relationship can be claimed at the .01 level (Garrett, 1953, p. 200). The r's found in the case of the Detroit and the Matrices tests, .22 and .27 respectively, are well in excess of this figure. We may claim, therefore, at the .01 level of confidence, that there is a definite relationship between total reading achievement and intelligence as measured by these tests. The r of .09, on the other hand, is well below the figure of .15

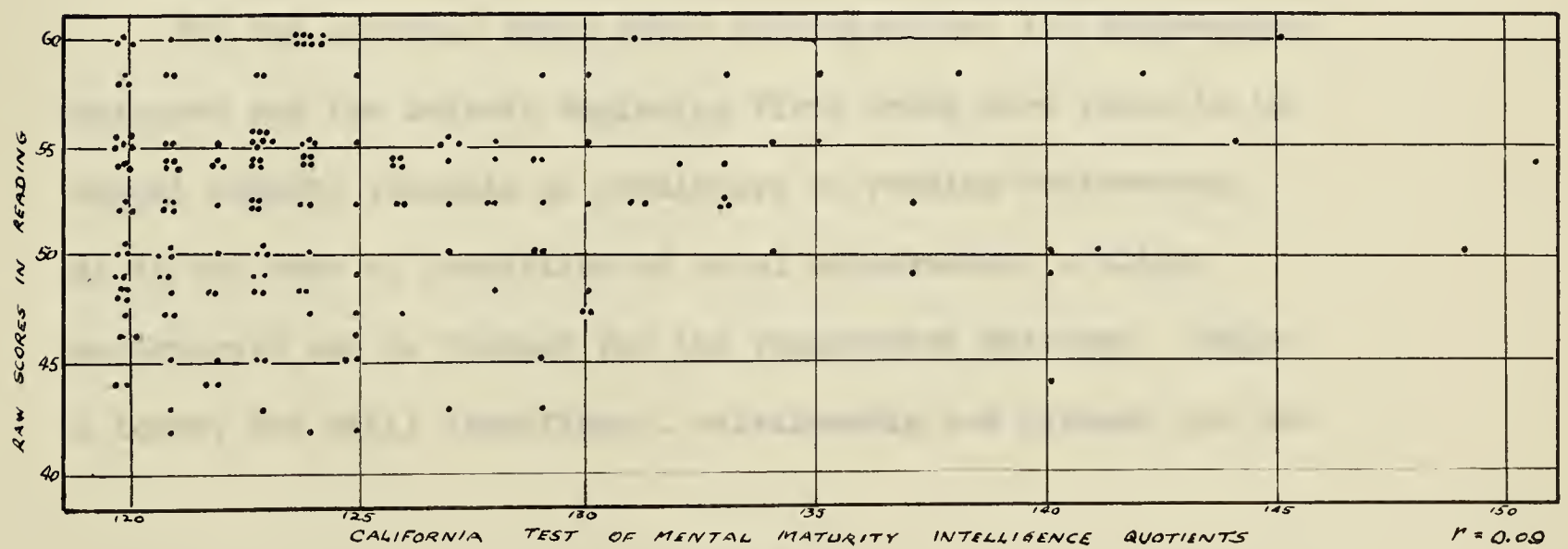
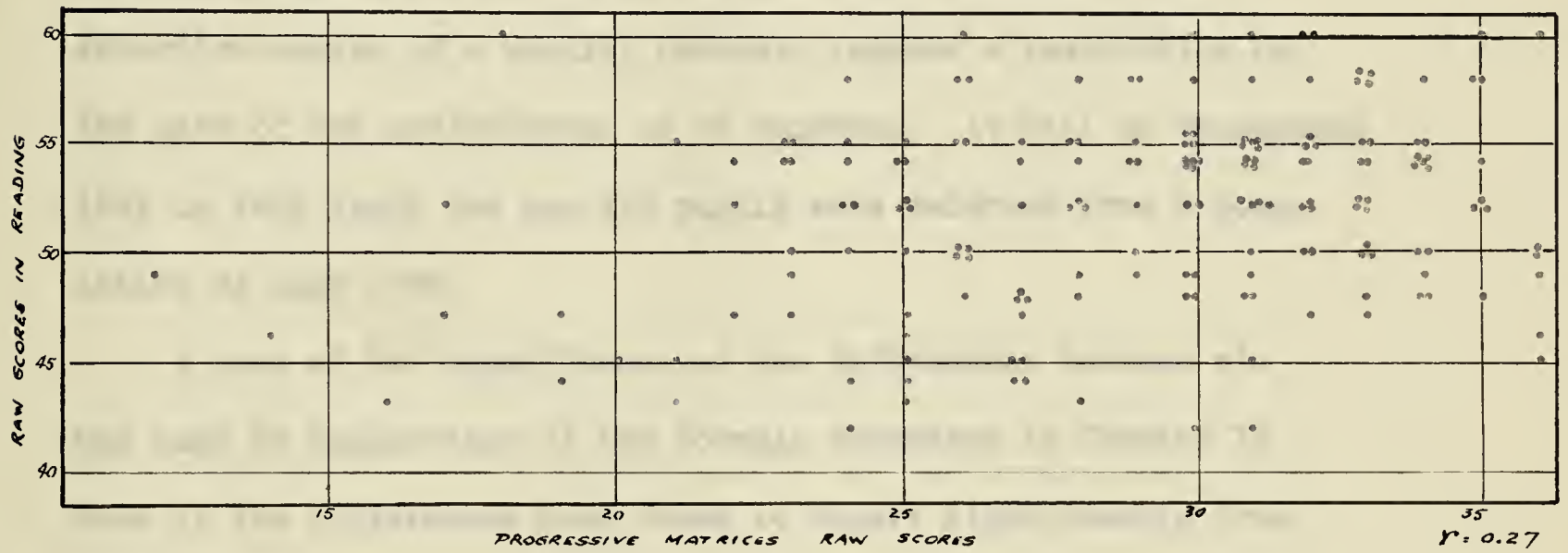
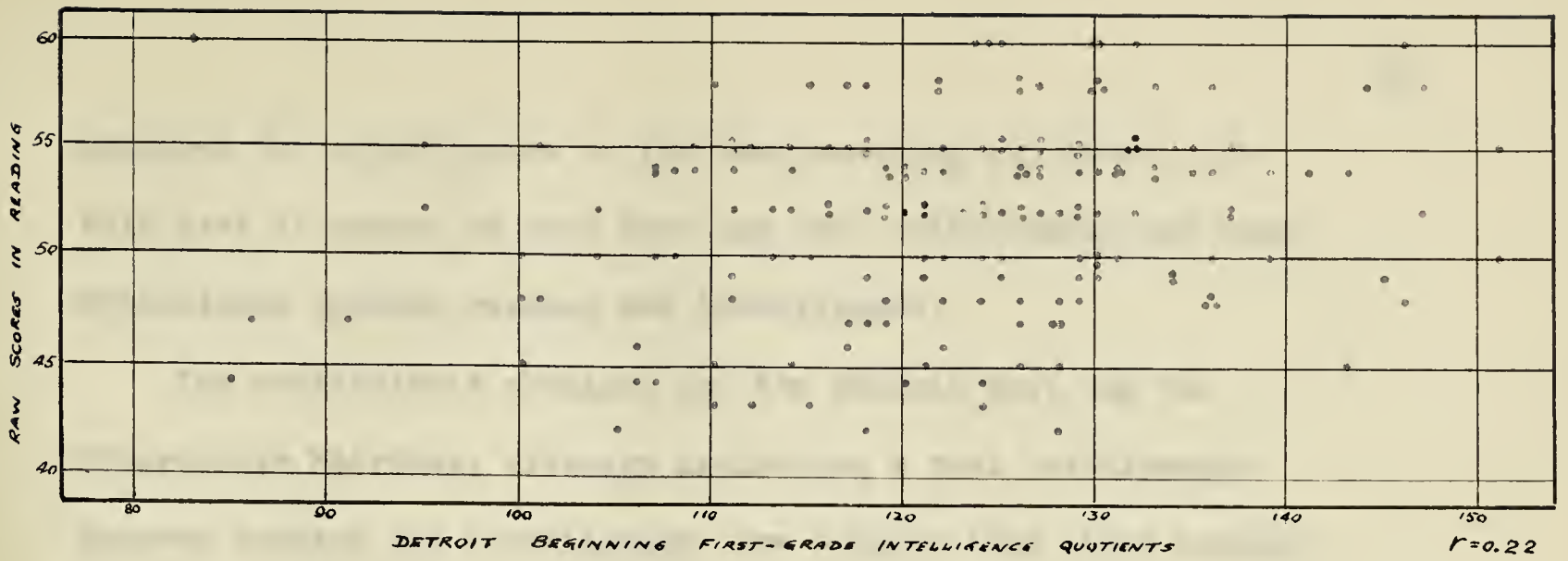


FIGURE 3

DISTRIBUTION OF INTELLIGENCE TEST SCORES
AND READING ACHIEVEMENT SCORES

required for significance at the less exacting .05 level. In this case it cannot be said that any real relationship has been established between reading and intelligence.

The coefficients obtained for the Detroit test and the Progressive Matrices, although indicating a real relationship between reading and intelligence, are smaller than those usually obtained in prediction studies involving more heterogeneous groups. In such studies, r 's of .40 to .60 are often obtained. The selective nature of a sample, however, imposes a restriction on the size of the coefficients to be expected. It will be remembered that in this study the top 178 pupils were selected from a population of some 3700.

A test of the significance of the differences between r 's was made by application of the formula discussed in Chapter IV. None of the differences were found to depart significantly from zero. Discussion of the predictive value of the intelligence tests is again subject to this reservation.

For the superior group under consideration, the Progressive Matrices and the Detroit Beginning First Grade were found to be almost equally valuable as predictors of reading achievement. As in the case of prediction of total achievement, a slight superiority can be claimed for the Progressive Matrices. While a lower, but still significant, relationship was claimed for the

California Test of Mental Maturity as a predictor of total achievement, no real relationship was found to exist between total reading and the California test.

As a predictor of reading achievement, the Detroit Beginning First-Grade was found to compare favorably with the Progressive Matrices, although it had been administered three years before the latter test. As compared with the California Test of Mental Maturity, which had the same time advantage as the Progressive Matrices, it is noteworthy that a significant correlation of .22 should have been obtained for the Detroit Beginning First-Grade while the California failed to qualify as a predictor.

Successful completion of the California intelligence test is dependent on comprehension of numerous verbal instructions and understanding of key words relative to the tasks required. Sections are included, moreover, which test vocabulary directly. Dependence on language is, to a lesser degree, also evident in the Detroit. The Matrices test is practically language free. In prediction of reading achievement, therefore, it might well be expected to fall below the other two intelligence tests. It should be noted that the opposite is the case. Its superiority to both of the more academic tests, and particularly the modern California Test of Mental Maturity, was indicated.

Summary

On the basis of coefficients of .27 and .22, both significant

at the .01 level, the Progressive Matrices and the Detroit intelligence tests were found to be valuable predictors of achievement in reading. The relationship between the California Test of Mental Maturity and reading achievement was so slight that there is no evidence of its usefulness in prediction.

CHAPTER VI

INTELLIGENCE AND LANGUAGE

The three intelligence tests which are under consideration throughout this study were compared as predictors of achievement in language. The language score employed is a composite of the sub-scores in English (capitalization and punctuation) and spelling. Product-moment coefficients computed to ascertain the correlation of the respective intelligence tests with language achievement are shown in Table IX.

TABLE IX
RELATIONSHIP BETWEEN INTELLIGENCE
AND LANGUAGE ACHIEVEMENT

Intelligence test	N	r	Level of significance
Detroit Beginning First-Grade	178	.32	.01
Progressive Matrices	178	.28	.01
California Test of Mental Maturity	178	.08	---*

*Not significant

Positive coefficients of correlation between achievement and all three intelligence tests were again obtained. For both the Detroit and the Progressive Matrices, these coefficients, .32 and

.28 respectively, were slightly lower than those previously found in the prediction of total achievement but higher than the coefficients between these tests and achievement in reading. As in the prediction of reading, a very small r (.08) was obtained between the California Test of Mental Maturity and language achievement. The larger coefficients were both found to be significant at the .01 level of confidence, while the .08 proved to be non-significant. The nature of the distributions from which these coefficients were obtained is shown in Figure 4.

In contrast to the results reported in previous chapters, significant differences in r 's were obtained in this case. For the differences between each of the larger coefficients, .32 and .28, and the coefficient of .08, t -values of 2.49 and 2.04 were calculated. These exceed the value of 1.97 required for significance at the .05 level. Superiority of the Detroit and the Matrices to the California in the prediction of language can be claimed, therefore, with a greater degree of confidence than was possible in the other subject areas.

Both the Detroit and the Progressive Matrices were found to be of value in the prediction of language achievement. The California Test of Mental Maturity was found to be as valueless in prediction of language achievement as it had been in the prediction of success in reading. The slight superiority of the Detroit over the Matrices as a predictor of language achievement is a reversal of the relative

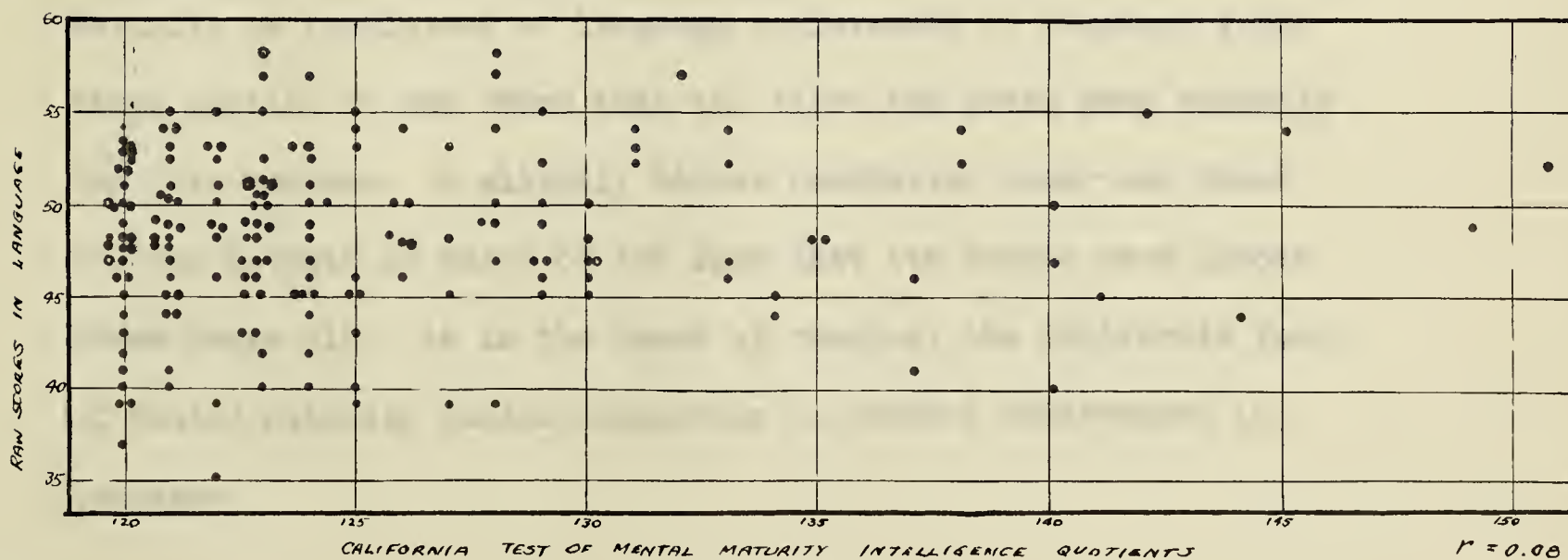
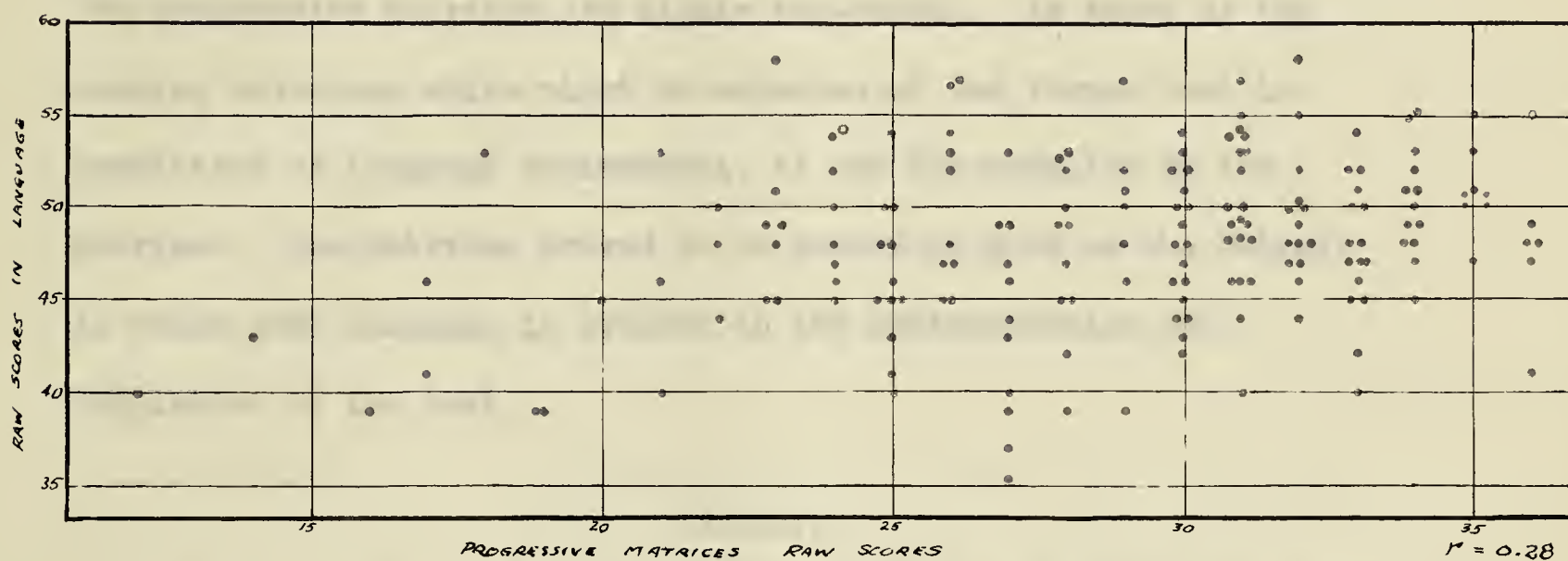
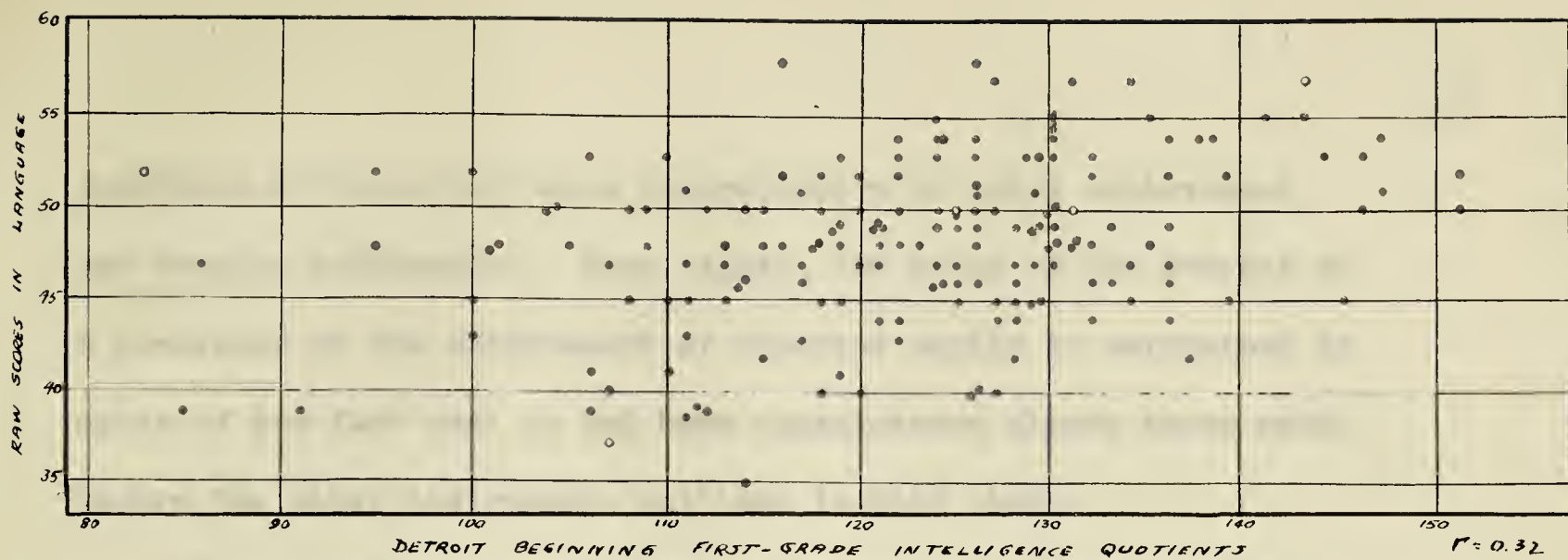
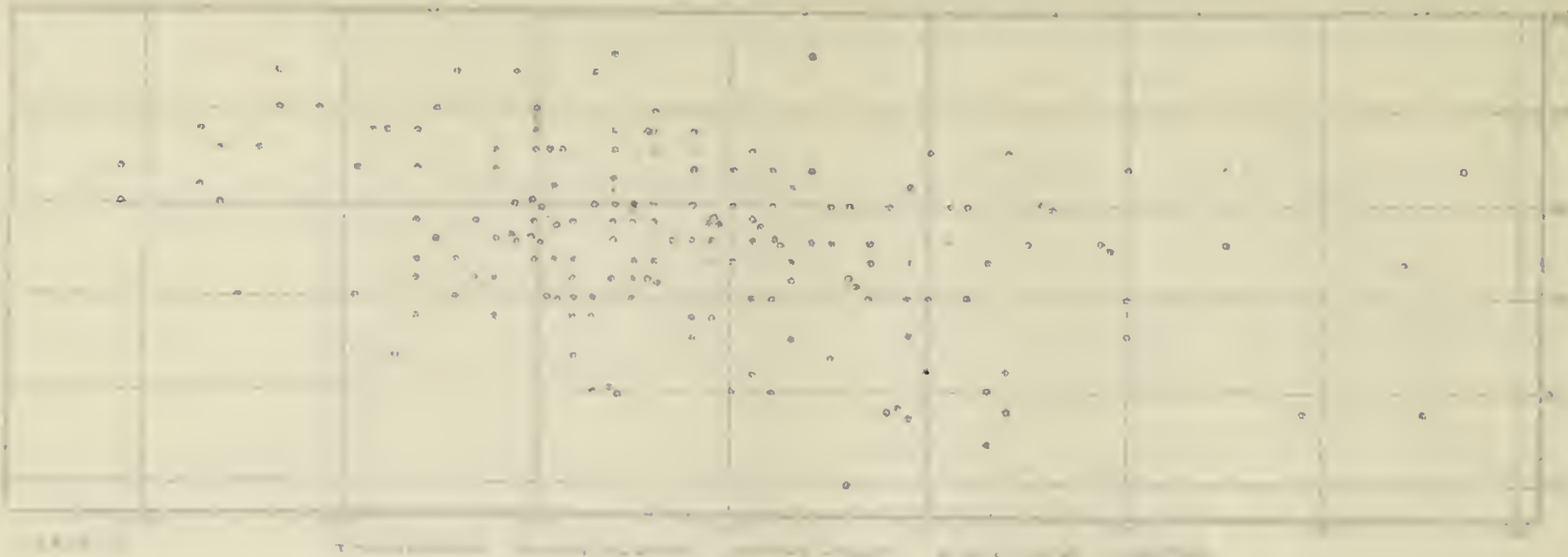


FIGURE 4

DISTRIBUTION OF INTELLIGENCE TEST SCORES
AND LANGUAGE ACHIEVEMENT SCORES

THE CHANGING SCENARIO OF THE DISTRIBUTION OF THE

PLANT



positions of these two tests as predictors of total achievement and reading achievement. Here, again, the value of the Detroit as a predictor of the achievement of superior pupils is maintained in spite of the fact that it had been administered almost three years before the other instruments utilized in this study.

In previous chapters, attention was drawn to the weighting with language, directly or indirectly, of the California test. The Progressive Matrices are highly non-verbal. In spite of the seeming advantage which might be expected of the former test in prediction of language achievement, it was far excelled by the Matrices. The Matrices proved to be almost as good as the Detroit in which some language is evident in the administration and completion of the test.

Summary

In a comparison of the Detroit Beginning First-Grade Intelligence Test, Raven's Progressive Matrices and the California Test of Mental Maturity as predictors of language achievement of superior grade three pupils, it was found that the first two tests were valuable for this purpose. A slightly higher predictive power was found for the Detroit in spite of the fact that its scores were almost three years old. As in the cases of reading, the California Test of Mental Maturity failed completely to predict achievement in language.

CHAPTER VII

INTELLIGENCE AND ARITHMETIC

The present study is concerned with the prediction of achievement, in several skill subjects, of superior grade three pupils. The California Achievement Test Battery, which was the criterion of achievement, yields a score in arithmetic as well as the total achievement score and scores in reading and language. The arithmetic score, like those in the other two subjects, is a composite of a number of sub-scores. Anastasi (1954) criticizes the use of the sub-scores in the California battery but expresses confidence in the total scores for each subject as adequate measures of achievement.

Again the three intelligence tests employed in this study were compared as predictors of achievement. Pearson product-moment coefficients of correlation were computed to ascertain if any relationship could be established between intelligence and achievement in arithmetic. Coefficients obtained are shown in Table X.

Positive coefficients of correlation were found between arithmetic achievement and each of the three intelligence tests. They included the highest coefficients obtained in this study and were higher for all three tests, than the correlation of

TABLE X
RELATIONSHIP BETWEEN INTELLIGENCE AND ARITHMETIC
ACHIEVEMENT

Intelligence test	N	r	Level of significance
Detroit Beginning First-Grade	178	.36	.01
Progressive Matrices	178	.36	.01
California Test of Mental Maturity	178	.20	.01

intelligence with total achievement or with achievement in reading or language.

Reference to Garrett's Table 25 (1953, p. 200) showed that the coefficients, .36, .36, and .20, were all significant at the .01 level. With this degree of confidence, it can be stated that all three intelligence tests are valuable as predictors of achievement in arithmetic of the superior group under consideration. In view of the significant relationship between the California Test of Mental Maturity and arithmetic achievement, it is of interest to compare the third scattergram shown in Figure 5 with the corresponding distributions in Figure 3, p. 36 and Figure 4, p. 42. In the latter cases, it will be recalled, the r 's were so small as to be non-significant.

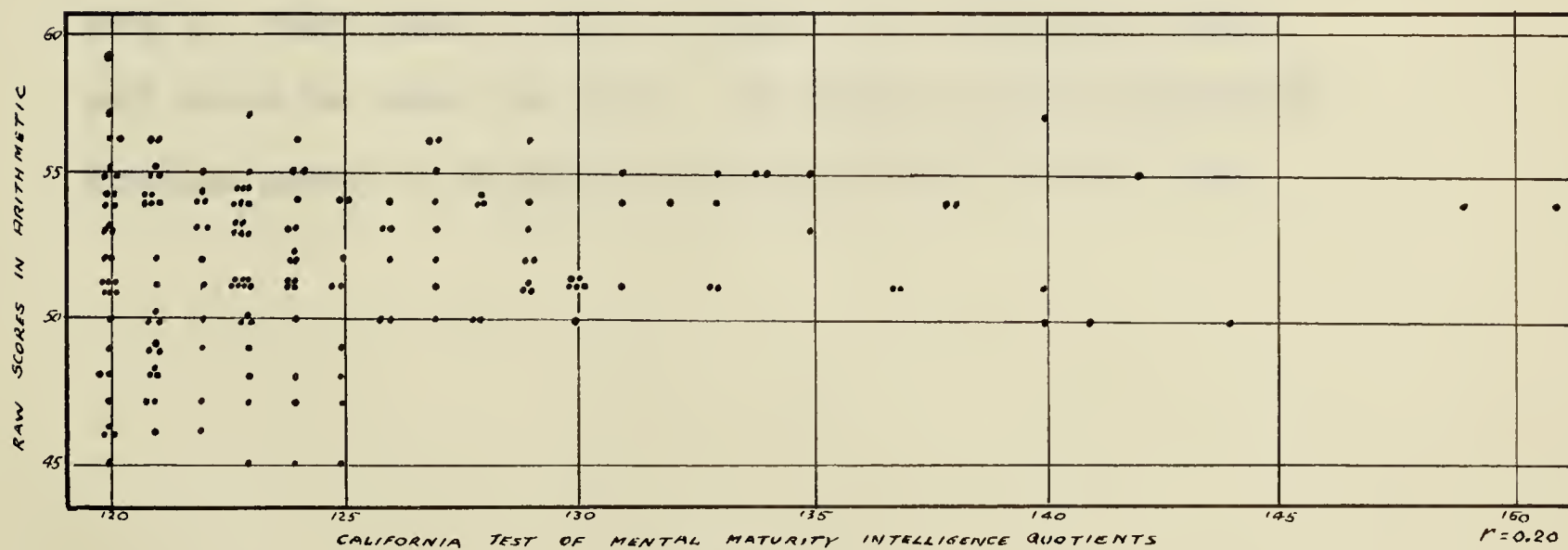
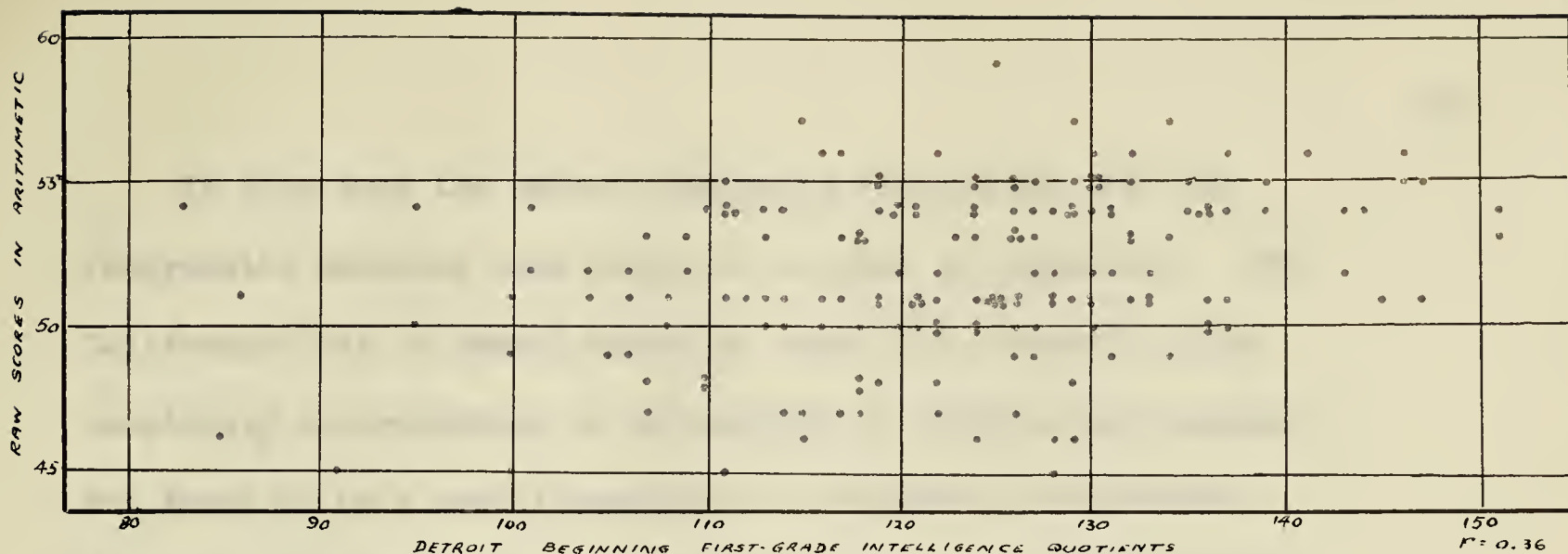


FIGURE 5

DISTRIBUTION OF INTELLIGENCE TEST SCORES
AND ARITHMETIC ACHIEVEMENT SCORES



FIGURE 2

LOCATION OF STUDY AREA
IN THE STATE OF TEXAS

In this area the Detroit Beginning First-Grade and the Progressive Matrices were found to be equal as predictors. The California Test of Mental Maturity, which had formerly failed completely in prediction of achievement in reading and language, was found to be a useful predictor of arithmetic achievement. Although the difference in r 's was not found to be significant ($t = 1.74$), the coefficients indicate that the California is inferior to both the Detroit and the Progressive Matrices. The Detroit intelligence test, administered almost three years before the other two tests, was again found to match the Progressive Matrices and to surpass the California as a predictor.

Summary

For prediction of arithmetic achievement, the Detroit Beginning First-Grade, the Progressive Matrices and the California Test of Mental Maturity were all found to be valuable instruments. Coefficients of correlation obtained were all significant at the .01 level. The California ranked well below the other two tests. The Detroit and the Progressive Matrices proved to be equal in predictive power in this area.

CHAPTER VIII

INTERCORRELATIONS OF INTELLIGENCE TESTS

Group intelligence tests were first thought of as substitutes for the Stanford-Binet and their correlations with that test were reported as evidence of their validity. (Cronbach, 1949). High correlation indicates that they measure to a high degree the same thing as the Stanford-Binet. Similarly, intercorrelations between group tests indicate the extent to which they measure the same aspects of intelligence. It has been stated that:

In general, intelligence tests give heaviest weight to two aptitudes, verbal comprehension and abstract reasoning. Other aptitudes are typically included but the ones included and the extent to which they are stressed depend upon the content and construction of the particular test. Differences between the results of various tests of intelligence can be explained in these terms (Humphreys and Boynton, 1950, p. 189).

Two of the intelligence tests employed in this study, the Detroit Beginning First-Grade and the California Test of Mental Maturity, are largely dependent on language, while the Matrices is largely a qualitative test of perception. The need for improvement of current verbal tests and their limitations in measuring intelligence have been pointed out by Cronbach: "If one can have high mental ability without having exceptional verbal ability ... many people have been rated unjustly by our present tests. Mental tests do not have to be verbal (1949, p. 189).

To compare the instruments used in this study as tests of intelligence of a superior group of grade three pupils, product-moment coefficients of correlation were computed. As language and non-language scores were provided by the California Test of Mental Maturity, comparisons were also made between each of these and the Detroit and the Progressive Matrices. Coefficients obtained are shown in Table XI.

TABLE XI.

INTERCORRELATIONS OF INTELLIGENCE TESTS

	Progressive Matrices	California Total	California Language	California Non-language
Detroit	.19	.09	.11	.05
Progressive Matrices		.10	.06	.10

While positive intercorrelations were obtained in all cases, ranging from .19 to .05, only the r of .19 was found to be significant at the .05 level. The other coefficients were so small as to be attributable to chance. It is of particular interest to note that the only significant intercorrelation found was between the Detroit, involving some language, and the language-free Progressive Matrices. No significant relationship was found between the Detroit and either the California, quite strongly based on language, or its language score which contributes largely to the total.

The two tests for which a significant intercorrelation was obtained were those which had been indicated as the best predictors of achievement. The Detroit Beginning First-Grade and the Progressive

Matrices were almost equally good predictors of total achievement as well as achievement in reading, in language and in arithmetic. In every case they were superior to the California Test of Mental Maturity.

Failure to find significant intercorrelations of the California with the Detroit and the Progressive Matrices may be partly due to differences in discriminative power of the tests among superior pupils. With reference to present-day intelligence tests, Cronbach draws attention to their inadequacy with respect to high-level mental ability. This may be due, it is suggested, to the difficulty, in distinguishing between high grades of ability, of choosing test items "calling for superior adaptive ability rather than advanced education" (1949, p. 189).

CHAPTER IX

CONCLUSIONS

Three intelligence tests, the Detroit Beginning First-Grade, Raven's Progressive Matrices and the California Test of Mental Maturity were compared as predictors of a superior group of grade three pupils. Product-moment coefficients of correlation between total achievement and intelligence were computed. Coefficients were likewise obtained between each of the achievement sub-tests (reading, language, arithmetic) and intelligence. Intercorrelations among the intelligence tests were investigated, including language and non-language scores of the California Test of Mental Maturity.

Significance of the coefficients obtained was tested against the null hypothesis. Where the coefficients were sufficiently large to warrant the claim of a real relationship between the variables under consideration, the degree of confidence in such relationship was noted.

Low, positive coefficients were obtained in all cases. As the sample studied constituted a highly selected superior group, correlations as high as those usually found with a heterogeneous population were not anticipated. Several of the correlations between achievement and intelligence were too small to indicate any real relationship. A summary of the correlations between

intelligence and achievement is given in Table XII.

TABLE XII
SUMMARY OF RELATIONSHIP BETWEEN
INTELLIGENCE AND ACHIEVEMENT

Intelligence test	Criterion of Achievement			
	Reading	Language	Arithmetic	Total
Detroit Beginning First-Grade	.22*	.32*	.36*	.33*
Progressive Matrices	.27*	.28*	.36*	.34*
California Test of Mental Maturity	.09 ^o	.08 ^o	.20*	.16**

*significant at the .01 level

**significant at the .05 level

^onot significant

It was found that the differences between the correlations of the three intelligence tests with reading did not depart significantly from zero. The same negative results were obtained for the correlations between intelligence and arithmetic and between intelligence and total achievement. In the case of language achievement, however, the differences between each of the larger r 's and the .08 figure were found to be significant at the .05 level.

The Detroit Beginning First-Grade intelligence test and Raven's Progressive Matrices were found to be the two best predictors of total achievement and of reading, language and arithmetic achievement. Coefficients of correlation between achievement and intelligence, as measured by these two tests, were all found to be significant at the .01 level. The Detroit

test proved slightly superior to the Matrices in prediction of language achievement and slightly inferior in prediction of total and reading achievement. The Detroit and the Matrices predicted arithmetic achievement equally well. The coefficients found between arithmetic achievement and each of these two intelligence tests, .36, were the highest obtained in the study.

The California Test of Mental Maturity ranked below the Detroit and the Progressive Matrices as a predictor in all four achievement categories. The highest coefficient for the California test was found in prediction of arithmetic. This coefficient, .20, was found to be significant at the .01 level of confidence. In the case of total achievement, significance was established at the .05 level. For reading and language, no real relationship can be claimed, on the basis of this study, between achievement of superior pupils and intelligence as measured by the California Test of Mental Maturity.

Intercorrelations of the intelligence tests failed to yield significant coefficients, with one exception. A coefficient of .19, significant at the .01 level, was found between the Detroit Beginning First-Grade intelligence test and the Progressive Matrices.

The Detroit Beginning First-Grade Intelligence Test and Raven's Progressive Matrices were both found to be consistently better predictors than the California Test of Mental Maturity.

Several considerations would seem to warrant additional comment on these results.

The predictive power of an intelligence test is decreased by any considerable lapse of time before administration of the criterion of achievement. That the Detroit, administered three years before the tests of achievement, should prove superior to the California is additional evidence of the value of this instrument for prediction of achievement of superior pupils.

The Matrices test is highly non-verbal. The author states that adequate directions can be given to pupils through demonstration rather than oral instruction, this making it completely independent of language. In the California test, not only are sections devoted to the direct appraisal of vocabulary and word meanings, but oral directions given throughout the test involve language facility. Intelligence tests which are largely dependent on language are usually found to be better than non-verbal tests for prediction of school achievement. Moreover, the California test is designed to measure spatial relations, and logical and numerical reasoning in addition to verbal concepts. Facility in each of these areas is also commonly associated with academic achievement. Yet the Progressive Matrices test was found to predict achievement somewhat better than the California. In this study of gifted children, the superiority of the Progressive Matrices suggests that general

mental ability, or g, as measured by this instrument through the application of visual perception to problem solving and without testing anything directly verbal or numerical, is more closely related to achievement than are the scores on the California Test of Mental Maturity.

BIBLIOGRAPHY

BIBLIOGRAPHY

- Alexander, A.M., "Teacher Judgement of Pupil Intelligence and Achievement is not Enough," The Elementary School Journal, March, 1953, pp. 396-401.
- Allen, Mildred M., "Relationship between the Indices of Intelligence Derived from the Kuhlmann-Anderson Tests for Grade I and the Same Tests for Grade IV," The Journal of Educational Psychology, 1945, pp. 252-256.
- Anastasi, Anne, Psychological Testing, New York: The Macmillan Co., 1954.
- Bailey, Helen K., "A Study of the Correlation between Group Mental Tests, the Stanford-Binet and the Progressive Achievement Test used in the Colorado Springs Elementary Schools," The Journal of Educational Research, October, 1949.
- Baker, H.S., "Second Thoughts on Grouping," The A.T.A. Magazine, March, 1959, p. 6.
- Barratt, Ernest S., "The Relation of the PM (1938) and the Columbia Mental Maturity Scale to the WISC," The Journal of Consulting Psychology, 1956, pp. 294-296.
- Barrett, Ernest S. and D.L. Baumgarten, "The Relation of the WISC and the Stanford-Binet to School Achievement," The Journal of Consulting Psychology, April, 1957, p. 144.
- Bishton, Rodger, "A Study of Some Factors Related to Achievement of Intellectually Superior Eighth Grade Children," The Journal of Educational Research, November, 1957, pp. 203-207.
- Bolton, Floyd B., "Experiments with the R. P. M., 1938," The Journal of Educational Research, April 1955, pp. 629-633.
- Bond, Elden, Tenth Grade Abilities and Achievement. New York: Bureau of Publications, Teachers' College, Columbia University, No. 813, 1940, as cited by Gates, Arthur I., A. T. Jersild and others, Educational Psychology, New York: Macmillan Company, 1949, p. 254.
- Burke, B. S., D. W. Jensen and L. M. Terman, Genetic Studies of Youth, Stanford: Stanford University Press, 1930.
- Burt, Cyril, Mental and Scholastic Tests, Westminster: P. S. King and Son, 1921 as cited by Gates, Arthur I., A.T. Jersild and others, Educational Psychology, New York: Macmillan Company, 1949, p. 253.
- Burt, Cyril, "The Reliability of Teacher Assessments," The British Journal of Educational Psychology, June, 1945, pp. 80-92.

- Burt, Cyril, "Review of P.E. Vernon's The Structure of Human Abilities" (London: Methuen and Co.), The British Journal of Educational Psychology, February, 1951, pp. 1-2.
- Burt, Sir Cyril, "Evidence for the Concept of Intelligence," The British Journal of Educational Psychology, November, 1955, pp. 158-177.
- Bryan, Miriam M., Review of Iowa Every-Pupil Test of Basic Skills, The Fourth Mental Measurement Yearbook (Oscar K. Buros, ed.), Highland Park: Gryphon Press, 1953, pp. 33-42.
- Carter, R. S. "Intellectual Variables Involved in Teachers' Marks," The Journal of Educational Research, October 1953, pp. 81-95.
- Cattell, Raymond B., "Review of CTMM," The Nineteen Forty Mental Measurements Yearbook (Oscar K. Buros, ed.), Highland Park: The Mental Measurements Yearbook, 1940, pp. 207-209.
- Climenhaga, Clarence E., "A Survey of Arithmetical Achievement of Grade Eight Pupils in Alberta Schools," The Alberta Journal of Educational Research, December, 1955, pp. 35-47.
- Cook, Walter W., "Achievement Tests," Encyclopedia of Educational Research (Walter S. Monroe, ed.), New York: The Macmillan Company, 1950, pp. 1461-1478.
- Cornell, Francis G., The Essentials of Educational Statistics, New York: John Wiley and Sons, 1956.
- Cronbach, Lee J., Essentials of Psychological Testing, New York: Harper and Brothers, 1949.
- Department of Education, "Promotion Policies in Alberta," Edmonton: 1957.
- De Haan, Robert F., "Identifying Gifted Children," The School Review, March, 1957, pp. 41-48.
- Emmett, W.G., "Secondary and Modern Grammar School Performance Predicted by Tests Given in Primary Schools," The British Journal of Educational Psychology, June, 1954, pp. 91-96.
- Faust, Clarence H., "Why the New Concern for Educating the Gifted?," The School Review, March, 1957, pp. 12-19.

- Findley, Warren G., "Review of California Achievement Tests," The Fourth Mental Measurements Yearbook (Oscar K. Buros, ed.), Highland Park: Gryphon Press, 1953, pp. 3-6.
- Foulds, G.A. and J.C. Raven, "An Experimental Survey with Progressive Matrices," The British Journal of Educational Psychology, June, 1950, pp. 104-110.
- French, J.W., "The Description of Aptitude and Achievement Tests in Terms of Rotated Factors," Psychometric Monographs, 1951, p. 278 as cited by Anastasi, Anne, Psychological Testing, New York: The Macmillan Co., 1954, p. 358.
- Garrett, Henry E., "The California Test of Mental Maturity," The Third Mental Measurements Yearbook (Oscar K. Buros, ed.), New Brunswick: Rutgers University Press, p. 304.
- Garrett, Henry E., Statistics in Psychology and Education, Toronto: Longmans, Green and Co., 1953.
- Gates, Arthur I., A. T. Jersild and others, Educational Psychology, New York: Macmillan Company, 1949.
- Gault, M.G., Report on Education of Gifted Children, The Alberta School Trustees, May, 1957, p. 10.
- Gavinchuk, M. N., "A Comparative Study of the Relation of Academic Achievement and Certain Intelligence Tests at the Junior High School Level, M. Ed. Thesis, 1954.
- Getzels, J. W., "Special Values and Individual Motives: the Dilemma of the Gifted," The School Review, March 1957, pp. 60-63.
- Green, Clinton W., "The Relation between Intelligence as Determined by Intelligence Tests and the Ability to Learn as Determined by Performance on Learning Tests," The Journal of Educational Research, November, 1953, pp. 191-200.
- Green, Meredith W. and Josephine C. Ewart, "Normative Data on the FM (1947)," The Journal of Consulting Psychology, 19-2, 1955, pp. 139-142.
- Greene, H.G., A.N. Jorgensen and J.R. Gerberich, Measurement and Evaluation in the Elementary School, Toronto: Longmans, Green and Co., 1947.
- Guilford, J.P., Fundamental Statistics in Psychology and Education, New York: McGraw-Hill Book Co., 1956.

- Housego, I.E. and G.L. Mowat, "Alberta Composite High Schools and Gifted Youth," The Alberta Journal of Educational Research, March 1959, pp. 23-30
- Humphreys, Lloyd L. and Paul L. Boynton, "Intelligence and Intelligence Tests," Encyclopedia of Educational Research (Walter S. Munroe, ed.), New York: The Macmillan Co., 1950, pp. 600-612.
- Jones, Idwal Jones, "Some Research Problems in Wales," The British Journal of Educational Studies, November, 1952, pp. 76-78.
- Jones, H. Gwynne, "Comments on 'The Validity and Interchangeability of Terman-Merrill and Matrices Test Data' by D. Walton," The British Journal of Educational Psychology, June 1956.
- Jordon, A.M., "Review of Detroit Advanced First-Grade," The Nineteen Forty Mental Measurements Yearbook (Oscar K. Buros, ed.), Highland Park: The Mental Measurements Yearbook, 1940, p. 218.
- Kelly, Truman L., Crossroads in the Mind of Man, Stanford University: Stanford University Press, 1928.
- Kemp, Leslie C.D., "Environmental and Other Characteristics Determining Attainment in Primary Schools," The British Journal of Educational Psychology, November, 1955, pp. 67-77.
- Kent, Grace H., Mental Tests in Clinics for Children, Toronto: Nostrand, 1950.
- Kimmitt, R.A., Report on an Accelerated Program, The Alberta School Trustee, June, 1958, p. 20.
- Kuhlmann, F., Review of the California S-Form Test of Mental Maturity, The Nineteen Forty Mental Measurements Yearbook, (Oscar Buros, ed.), Highland Park: The Mental Measurements Yearbook, 1940, p. 209.
- Lavirs, F. P., "They Are All Learners," The B.C. Teacher, March, 1957, pp. 274-276.
- Laycock, Samuel R., "What Can We Do for Gifted Children?," The Alberta School Trustee, March, 1958, pp. 17-19.
- Lynes, Russell, "The Importance to Our Society of High Level Talent," Educational Digest, January, 1958, pp. 10-13.

McLeod, A., "Special Needs in Education," The Alberta School Trustee, July-August, 1958, pp. 16-20.

Martens, Elise H., "Gifted Children," The Nation's Schools, June, 1951, pp. 31-34.

Miles, T. R., "Contributions to Intelligence Testing and the Theory of Intelligence," The British Journal of Educational Psychology, November, 1957, pp. 153-165.

Newland, T. Ernest, "The Mentally Gifted," The Review of Educational Research, June 1941, pp. 277-287.

Newland, T. Ernest, "The Gifted," The Review of Educational Research, December, 1953, pp. 417-431.

Odell, C. W., Review of the California Achievement Tests, The Nineteen Forty Mental Measurements Yearbook (Oscar K. Buros, ed.), Highland Park: The Mental Measurements Yearbook, 1940, p. 38.

Passow, A. Harry, "The Talented Youth Project: a Report on Research under Way," Educational Research Bulletin, College of Education, Ohio State University, September, 1957, pp. 199-206.

Peel, E.A. and D. Rutter, "The Predictive Value of Entrance Examinations as Judged by the School Certificate Examination," The British Journal of Educational Psychology XXI, 1951, pp.30-35.

Pintner, Rudolph, Intelligence Testing, New York: Henry Holt and Company, 1930.

Richardson, S.C., "Some Evidence Relating to the Validity of Selection for Grammar Schools," The British Journal of Educational Psychology, February, 1956, pp. 15-24.

Russell, Donald W., "A Functional Approach to the Study of the Gifted Child," The Elementary School Journal, October, 1957, pp. 45-47.

Scarfe, N. V., "Homogeneous Intellectual Grouping," The Educational Courier, June, 1956, p. 10.

Schindler, Alvin W., Review of California Achievement Tests, The Fourth Mental Measurements Yearbook (Oscar K. Buros, ed.), Highland Park: Gryphon Press, 1953, pp. 6-7.

- Sheldon, Wm. D. and Manolakes, "A Comparison of the Stanford-Binet, Revised From L, and the California Test of Mental Maturity (S-Form)," The Journal of Educational Psychology, December, 1954, pp. 499-584.
- Shipley, Walter C., Review of the Progressive Matrices, The Third Mental Measurements Yearbook (Oscar K. Buros, ed.), New Brunswick, Rutgers University Press, 1949, p. 338.
- Shores, J. Harlan, Review of California Achievement Tests, The Fourth Mental Measurements Yearbook (Oscar K. Buros, ed.), Highland Park: Gryphon Press, 1953, pp. 7-9.
- Spearman, C., The Abilities of Man, their Nature and Measurement, London: Macmillan and Co., 1927.
- Sperrazo, Gerald and Walter L. Wilkins, "Further Normative Data on the PM," The Journal of Consulting Psychology, February, 1958, pp. 35-37.
- Stephens, J. M., Educational Psychology, New York: Henry Holt and Co., 1951.
- Stephenson, Wm., Testing School Children, London: Longmans, Green and Co., 1949.
- Stroud, James B. and Paul Bloomers, "Correlation Analysis of WISC and Achievement Tests," The Journal of Educational Psychology, January, 1951, pp. 18-26.
- Sullivan, Elizabeth, Willis W. Clark and Ernest W. Tiegs, Manual to the California Short-Form Test of Mental Maturity, Los Angeles: California Test Bureau, 1953.
- Terman, Lewis M. and M. H. Oden, "The Gifted Child Grows Up," Genetic Studies of Genius, Vol. 4, Stanford: Stanford University Press, 1947 as cited by T. E. Newland, "The Gifted," Review of Educational Research, December, 1953, pp. 415-420.
- Thurstone, L. L., Primary Mental Abilities, Chicago: The University of Chicago Press, 1938.
- Tuddenham, R. D., "An Experimental Group Version for School Children of the Progressive Matrices," The Journal of Consulting Psychology, February, 1958, p. 30.

- Warrington, Willard G. and Joe L. Saupe, "Development and Application of General Mental Ability," The Review of Educational Research, February, 1959, pp. 15-25.
- Wechsler, D. M., "Review of Progressive Matrices," The Third Mental Measurement Yearbook, (Oscar K. Buros, ed.), New Brunswick: Rutgers University Press, 1949, pp. 338-339.
- Westby, George, "Review of Progressive Matrices," The Fourth Mental Measurements Yearbook (Oscar K. Buros, ed.), Highland Park: Gryphon Press, 1953, pp. 418-422.
- Witty, Paul A., "Review of the Primary Battery, Progressive Achievement Tests," The Third Mental Measurements Yearbook, (Oscar K. Buros, ed.), New Brunswick: Rutgers University Press, 1949, p. 29.
- Wood, H. G., "Review of California Achievement Tests," The Nineteen Forty Mental Measurements Yearbook (Oscar K. Buros, ed.), Highland Park: The Mental Measurements Yearbook, 1940, p. 39.
- Wrigley, Jack, "The Relative Efficiency of Intelligence and Attainment as Predictors of Success in Grammar Schools," The British Journal of Educational Psychology, June 1955, pp. 107-116.

